Phase II Project Summary

Firm: Intelligent Automation, Inc.
Contract Number: NNX09CA55C
Project Title: Reconfigurable L-Band transceiver using Direct Digital Synthesis

Identification and Significance of Innovation: (Limit 200 words or 2,000 characters whichever is less)

Conventional radar transceivers primarily consist of analog components, which are costly to design and at the same time, they are compatible only to a narrow range of applications. Modern digital technologies offer a great resource for digital radar design. Numerous radar applications that require waveform management can use digital synthesis techniques to achieve optimum radar performance. Modern real beam radars often use a variety of waveform types to achieve different objectives. This Phase II effort proposed and achieved the following key innovations:

- High update rate software configurable Direct Digital Synthesizer (DDS) design for multi-channel transmitter architecture.
- High-sampling rate (250 MHz and above), multi-channel digital receiver design. On-board signal processing capabilities will be integrated in the receiver design. This includes digital implementation of commonly used radar receiver architectures (Digital beam-forming and SAR Imaging)
- Scalable and modular hardware architecture to support multiple radar missions. Such a design approach would also address the issue of portability between different reconfigurable logic device families/ vendors.
- Path-to-Space design to minimize radiation hardened re-spin of digital processor boards.

Technical Objectives and Work Plan: (Limit 200 words or 2,000 characters whichever is less)

The overall objective of the Phase-II was to develop a reconfigurable digital radar processor with a path towards space transition. This processor should be able to synthesize multi-channel digital waveforms and process multi-channel waveforms in a coherent manner. The objective list is as below:

Objective 1: Develop the digital processor schematic, layout accommodating NASA Space mission requirements.
Objective 2: Fabricate the digital processor and test overall functionality for NASA applications.
Objective 3: Design a 16-channel Transmitter-Receiver setup to interface and operate coherently.
Objective 4: Develop simulator for Digital Beam-Former and SAR Processing for NASA mission requirements
Objective 5: Implement fixed point real-time algorithm from the simulator results, on the digital processor
Objective 6: Transition the complete system with the firmware to NASA test-bed for future missions.

Technical Accomplishments: (Limit 200 words or 2,000 characters whichever is less)

IAI successfully completed the schematics and layout of the RDRT after peer reviews by NASA. The RDRT is designed with a vision for transitioning to Space applications. This Path-to-Space design goal was achieved by developing the RDRT with commercial components having radiation-hardened counterparts. It was agreed that NASA will do a re-spin for fielding the RDRT in Space. By following the path-to-space approach, we reduce risks and make the radar implementation feasible. For Radar Digital Signal Processing (DSP), IAI and NASA Goddard agreed upon two candidate architectures. This included a Digital Beam-former firmware and SPECAN SAR Firmware. The digital beam-former was fully tested and implemented in real-time on prototype hardware. A complete simulator to generate point target images was completed for SPECAN Algorithm. The RDRT companion modules were also fabricated. These included the 16-channel digital transmitter/ receiver, Clock synthesizer and Configuration controller. The Phase2e award from NASA Goddard involved the design of an interleaved L-band Radiometer and an L-band Pulsed Radar. IAI designed and delivered the complete interleaver system with GPS time tags and a 2.4GHz wireless data acquisition link.

NASA Application(s): (Limit 100 words or 1,000 characters whichever is less)

The Phase-II technology is built upon the radar design and communications expertise of IAI, developed over several SBIR and non-SBIR contracts. Our proposed techniques can be used for a wide range of remote sensing applications for NASA including:

- Path-to-Space High speed digital processors
- Weather surveillance radar for aircrafts
- Earth science measurements like surface deformation, topography and soil moisture measurements
- Non-cooperative target tracking radar in air space

Non-NASA Commercial Application(s): (Limit 200 words or 2,000 characters whichever is less)

The most promising Non- NASA commercial applications are:

- Reconfigurable radar for commercial applications
- Cognitive Radios/ Radar for Defense related applications
- High bandwidth arbitrary waveform generator/ processor
- UAV surveillance radars, Automotive Radars.

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